

## Claims

We claims:

- 1    1. A method for selecting multiple paths between a server and a client in an overlay network having a plurality of nodes connected by links, the plurality of nodes including the server and the client, each path including a set of selected links, comprising:
  - 5       measuring, in each node, quality of service metrics of each link directly connecting the node to an immediate neighboring node;
  - 7       transmitting the metrics to the server;
  - 8       maintaining, in the server, the metrics, a link correlation matrix based on the metrics, and a path correlation matrix based on the link correlation matrix; and
  - 11      selecting the multiple paths based only on the metrics, the link correlation matrix, and the path correlation matrix.
- 1    2. The method of claim 1, further comprising:
  - 2       streaming data from the server to the client via the multiple paths.
- 1    3. The method of claim 1, further comprising:
  - 2       storing a copy of the data only at the server.
- 1    4. The method of claim 2, in which the streaming data are multimedia.
- 1    5. The method of claim 1, in which the link correlation matrix is

$$2 \quad Cr(L_{ij}, L_{mn}) = 1/2 + \frac{E[(L_{ij} - \bar{L}_{ij})(L_{mn} - \bar{L}_{mn})]}{2\sqrt{E(L_{ij}^2) - (\bar{L}_{ij})^2}\sqrt{E(L_{mn}^2) - (E(\bar{L}_{mn}))^2}},$$

3        where  $ij$  and  $mn$  are a pair of links connecting two nodes,  $E$  is an  
 4        expectation,  $L_{ij}$  and  $L_{mn}$  are the metrics for link  $ij$  and link  $mn$ , and an  
 5        average  $\bar{L}_{ij} = E(L_{ij})$ .

1        6. The method of claim 1, in which the metrics include bandwidth, latency,  
 2        and packet loss rate of the link.

1        7. The method of claim 1, in which the measuring, transmitting,  
 2        maintaining, and selecting are performed dynamically and periodically over  
 3        a time window.

1        8. The method of claim 5, in which the path correlation matrix is

$$2 \quad Cr(Path_A, Path_B) = \sum_{a \in A} \sum_{b \in B} Cr(a, b),$$

3        where the path<sub>A</sub> includes a link set  $a \in A$  and the path B includes a link  
 4        set  $b \in B$ .

1        9. The method of claim 8, further comprising:

2            first selecting a first path based on the metrics;  
 3            updating an available bandwidth of each link according to previously  
 4        selected paths;  
 5            determining a correlation cost ( $cc$ ) for each link  $L$  with respect to a  
 6        previous selected link set  $S$  of a path as

$$7 \quad Cr_S^L = \sum_{a \in S} Cr(L, a);$$

8 combining the correlation cost and the metrics to obtain a cost for  
9 each link using a cost function

10  $Cost_s^L = \alpha \cdot Cr_s^L + \sum_{i=1}^R \alpha_i W_r(i, j),$

11 where  $W$  are the metrics, and  $\alpha$  and  $\alpha_i$  are weighting factors; and  
12 selecting a next shortest path based on the updated cost  $Cost_s^L$ ; and  
13 repeating the updating, determining, combining, and selecting until  
14 the plurality of paths have been selected.